

POPULATION GROWTH

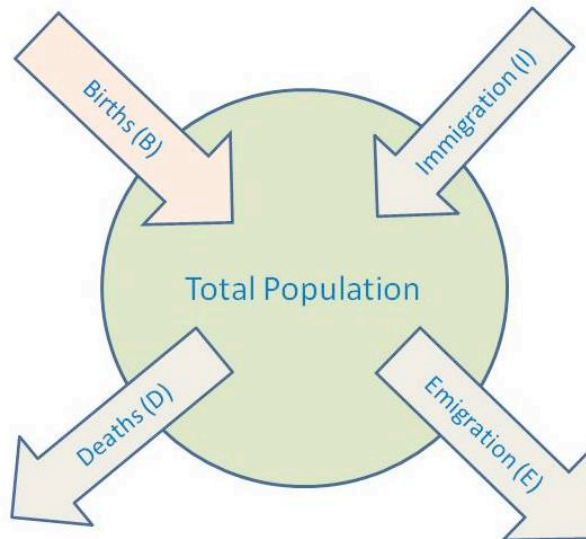
(How is population growth naturally regulated?)

Why?

The current world population is estimated to be over 6.8 billion. At present the number of births annually exceeds the number of deaths, which means that the population is increasing, and is estimated to reach 9 billion by 2040. Back in 1750 the world population was estimated at less than 800 million.

How are growing populations such as ours, controlled and supported and can they continue to grow indefinitely?

Model 1: Population Growth



1. What is the term used for populations moving into an area?
2. What is the term used for populations leaving an area?
3. What two factors cause an increase in the population size?
4. Name two factors that cause a decrease in population size.

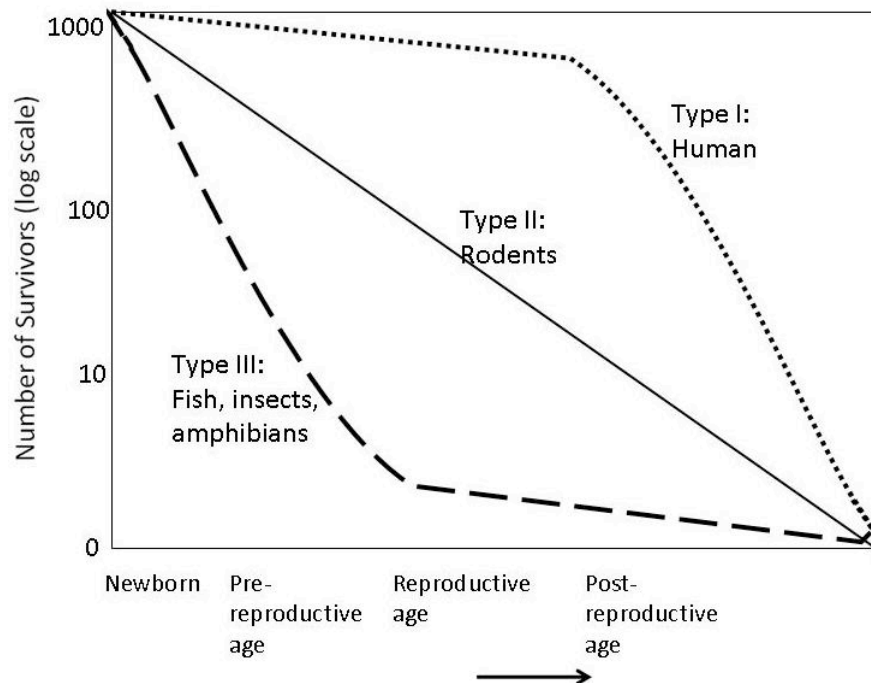


5. Using the diagram and the letters B, D, E & I, write mathematical expressions to show the following:

- A stable population:
- A declining population:
- A growing population:
- Population growth:



Model 2: Survivorship Curves



- What does the x-axis on the graph represent?
- Which type of organism shows a steady decline at all life stages?
- Which type of organism loses most of their individuals at an early life stage?
- What survivor type are humans?

10. Using complete grammatical sentences, with your group describe the pattern of survivorship for type I individuals.
11. When the number of survivors is 100, at what life stage is each survivor type?
- a. Type I –
 - b. Type II -
 - c. Type III –
12. Which of the three groups/types have the highest number of individuals that reach reproductive age?
13. What is the difference in the average number of offspring that can potentially be produced by each of the three survivorship types?
14. How do populations with type II or III survivorship compensate for the high pre-reproductive mortality?
15. Considering the evolutionary strategies that each survivorship type has developed for producing and rearing their young, can you develop a hypothesis as to why type I survivors have the highest relative number of individuals/1000 births that survive until post-reproductive age?



16. Under what circumstances might human populations not show type I survivorship.



Model 3: Growth Curves

Diagram A – Exponential Growth Curve

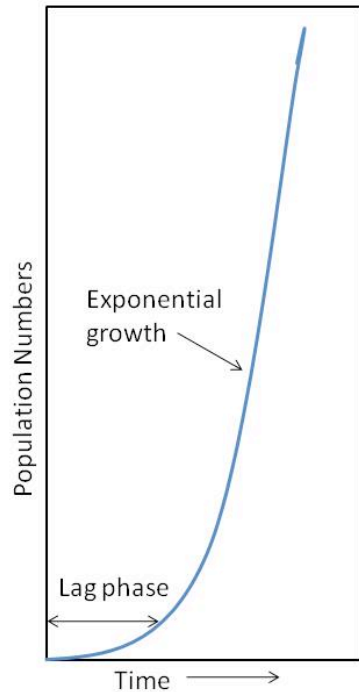
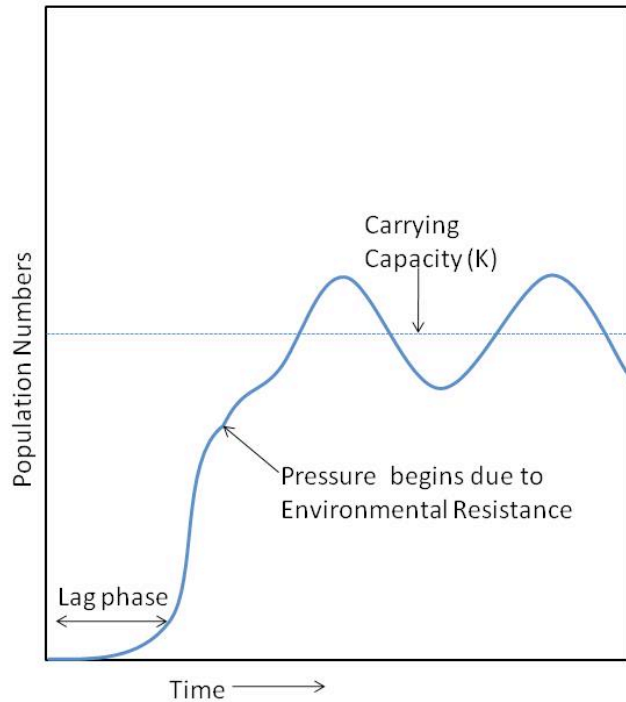


Diagram B – Logistic Growth Curve



17. During what phase of the growth curves is the population just beginning to colonize an area?
18. In which graph does the population growth appear to continue unchecked?
19. How is this type of growth described?
20. These types of growth curves are often referred to using the letter of the alphabet that they resemble. The logistic growth curve is sometimes referred to as an **S- curve**. What letter would you use to describe the exponential growth curve?
21. In diagram B what causes the population growth to slow down?
22. What term is used to describe the steady population that the environment can sustain in diagram B?



23. What factor(s) allow both population curves to show a period of rapid growth immediately after the lag phase?
24. Exponential growth (diagram A) refers to the phenomena of populations that double in size every generation. If you start with a single bacterium capable of dividing every 20 minutes, how many bacteria would you have after just 2 hours?



25. In most natural populations (diagram B) rapid exponential growth is unsustainable. As populations increase **environmental resistance** causes the growth rate to slow down, until a stable and sustainable population size is reached. With your group discuss and define the term environmental resistance, giving examples.
26. Diagram B shows that the population size fluctuates around the carrying capacity. Considering what you know about interactions in the environment, discuss with your group some of the factors that could cause these fluctuations. In your answer you should relate these factors to the information from model 1.



Extension Questions

Read This!

Invasive species are ones that are introduced into an environment but are not naturally found in that environment. One example of an introduced invasive species is the American gray squirrel, introduced into Britain at the end of the 18th century. Until 1876 the only native squirrel in Britain was the European red squirrel, which was found in deciduous and coniferous forests. By 1940 the gray squirrel had displaced the red squirrel across most of the British Isles, and by 1984 the red squirrel was only found in isolated coniferous woodland areas. After its initial introduction the gray squirrel population increased rapidly however in recent year's population sizes within specific environments have become stable.

27. Explain why the newly introduced gray squirrel initially showed rapid population growth and why the native red squirrel showed a population decline. Use ecological terms from the previous models in your answer.

28. Why has the population size of the gray squirrel become stable in recent years?